

APPENDIX

VERSION SHOWING CHANGES MADE TO SPECIFICATION

The paragraph starting at page 1, line 17 and ending at line 24, has been amended as follows:

--Recently, a so-called excimer laser has attracted [attracts] attention as the only [one] high-output laser that oscillates in the ultraviolet region, and a wide range of applications of the excimer laser can be expected in the electronic industry, chemical industry, energy industry and the like, specifically, in the processing of and in chemical reactions [reaction] with [respect to] metals, resins, glass, ceramics, semiconductors and the like.--

The paragraph starting at page 1, line 25 and ending at page 2, line 14, has been amended as follows:

--The principle [of] function of an excimer laser oscillating device will be described. First, a laser gas such as Ar, Kr, Ne, He, F<sub>2</sub> and the like filled in a laser chamber is excited by electronic-beam emission, electric discharge or the like. At this time, the excited F atoms are combined with inert Kr and Ar atoms in a ground state, generating molecules KrF\* and ArF\* which exist only in an excited state. The molecules are called excimers. The excimers, which are unstable, immediately emit ultraviolet light and dissociate to [dissociated in] the ground state. The excimer laser oscillating device utilizes the ultraviolet light emitted from the excimers. The device amplifies the ultraviolet light in

an optical resonance device comprising a pair of reflection mirrors as light having a regulated phase, and outputs the light as laser light.--

The paragraph starting at page 2, line 15 and ending at line 23, has been amended as follows:

--Upon excimer laser-light emission, as well as the above-described electronic beam and electric discharge, a microwave is used as a laser-gas excitation source. The microwave is an electromagnetic wave having an oscillation frequency within a range from several hundred MHz to several ten GHz. In this case, a microwave is introduced from a waveguide [awaveguide] via a gap (slot) formed in a waveguide [awaveguide] wall into a laser tube, to excite the laser gas in the laser tube into a plasma state.--

The paragraph starting at page 2, line 24 and ending at page 3, line 9, has been amended as follows:

--However, [Note that] even if the intensity distribution of the microwave emitted from the slot is uniform, in order to supply the microwave in a long space filling the length of the laser-light resonance device, it is necessary to form a slot array structure where plural slots are arrayed along the lengthwise direction of the resonance device. Fig. 9 shows this structure. Plural minute gaps (slots) 202 are formed at equal intervals in a waveguide [awaveguide] wall 201. The microwaves are emitted from the minute gaps

(slots) 202. In Fig. 9, discharge space within the laser tube [as discharge space] is omitted for the sake of convenience.--

The paragraph starting at page 3, line 21 and ending at page 4, line 4, has been amended as follows:

--The present invention has been proposed to solve the above-described conventional problems, and [has] its object is to provide a laser oscillating apparatus which realizes entirely uniform plasma discharge along a lengthwise direction of a laser tube, and enables laser light emission with minimum energy loss, having a structure which can be very easily designed, a high-performance exposure apparatus having the laser oscillating apparatus, and a high-quality device fabrication method using the exposure apparatus.--

The paragraph starting at page 5, line 15 and ending at page 6, line 2, has been amended as follows:

--Further, according to another aspect of the present invention, provided is a laser oscillating apparatus for exciting a laser gas by an electromagnetic wave and resonating generated plasma light so as to generate laser light, comprising a waveguide [waveguide] comprising a pair of chambers each internally supplied with the laser gas, wherein the waveguide [thewaveguide] has a slit-shaped gap in a lengthwise direction, and the chambers communicate with each other via the gap, and wherein the electromagnetic wave is generated in one of the chambers and is propagated to the other one of the

chambers through the gap, to continuously cause the plasma light over the entire area along the lengthwise direction where the gap is formed.--

The paragraph starting at page 6, line 14 and ending at line 15, has been amended as follows:

--In the laser oscillating apparatus, [wherein] the electromagnetic wave is a microwave.--

The paragraph starting at page 6, line 16 and ending at line 20, has been amended as follows:

--Further, according to the present invention, in the laser oscillating apparatus, [wherein] the laser gas is at least one inert gas selected from Kr, Ar, Ne, and He or a gaseous mixture of the at least one inert gas and an F<sub>2</sub> gas.--

The paragraph starting at page 8, line 8 and ending at page 9, line 9, has been amended as follows:

--The laser oscillating apparatus of the present invention has a [the] waveguide comprising the pair of chambers above and below a slit-shaped gap formed along the lengthwise direction (laser light generation direction), and the gap [has] functions as the electromagnetic-wave emission source and the plasma light emission portion. In this case, when the electromagnetic wave (microwave) is generated in one of the chambers, the

electromagnetic wave exists in a standing wave state in the chamber, and in correspondence with the standing wave, plasma discharge is performed with especially large emission light quantity in a position corresponding to the antinode of the standing wave. At this time, in a position where the plasma density is low, i.e., a position corresponding to the wave node of the standing wave, the electromagnetic wave enters the other chamber through the gap. If the other chamber is designed to invert the distribution of the standing wave, plasma discharge is performed such that the plasma density becomes the highest in a position through which the electromagnetic wave is transmitted. That is, in this case, the plasma discharge from the other chamber is performed self-consistently such that a high density position interpolates a low density position in the former chamber. Accordingly, plasma light occurs continuously over the entire space (along the entire lengthwise direction), and uniform laser light emission can be realized.--

The paragraph starting at page 11, line 5 and ending at line 6, has been amended as follows:

--Fig. 9 is a schematic cross-sectional view of the conventional waveguide [conventionalwaveguide].--

The paragraph starting at page 11, line 14 and ending at line 17, has been amended as follows:

--Hereinbelow, a first embodiment of the present invention will be described.

In this embodiment, an excimer laser oscillating apparatus which emits so-called excimer laser light will be exemplified.--

The paragraph starting at page 12, line 10 and ending at line 17, has been amended as follows:

--A laser gas as a raw material for laser light generation is supplied to the outside of the microwave generation unit 21, i.e., a region including at least the shielding structure 11, and a microwave is emitted from the emission source 22 of the microwave generation unit 21. Then, electric field concentration occurs in the gap 3 positioned in front of (above) the emission source 22, and plasma discharge occurs in the gap 3.--

The paragraph starting at page 13, line 10 and ending at page 14, line 4, has been amended as follows:

--Accordingly, to avoid the above electric field concentration and light emission, it is necessary to prevent the electric field concentration in the emission source 22, i.e., to increase the slot width of the emission source 22. More specifically, in the relation between the slot width of the emission source 22 and the gap 3, it is preferable that the slot width is wide to suppress the electric field around the slot so that the electric field is [to be] lower than the electric field needed to start plasma discharge. Further, as a condition for prevention of electric discharge by electric field concentration around the slot and for electric discharge by electric field concentration in the slit-shaped gap 3, positioned



away from and above the slot, the slot width is preferably equal to or wider than the slit-shaped gap 3. Considering this condition, preferably, the opening of the emission source 22 is [rather] a nearly-square rectangular shape, an elliptic shape or the like, rather than the slot shape. It is preferable that the emission source has an array structure where plural minute gaps having such shape are arrayed in a lengthwise direction.--

The paragraph starting at page 14, line 15 and ending at line 26, has been amended as follows:

--As shown in Fig. 2A (schematic cross-sectional view) and Fig. 2B (schematic cross-sectional view cut along an alternate long and short dashed line A-A' in Fig. 2A), the excimer laser oscillating apparatus has a laser tube 2 which emits laser light by resonating light emitted by excitation of excimer laser gas, a waveguide [a waveguide] 1 to excite the excimer laser gas in the laser tube 2 into a plasma state, and a coolant container 7 having a coolant input/outlet port 9 for cooling the waveguide 1. The waveguide 1 corresponds to the microwave generation unit 21 (Fig. 1) in the above-described plasma discharge mechanism.--

The paragraph starting at page 16, line 1 and ending at line 17, has been amended as follows:

--The waveguide [The waveguide] 1 supplies a microwave to the laser gas in the gas supply path structure 11. As [clearly] illustrated in Fig. 2A, the waveguide 1 has plural slots 4. As described above, each slot 4 preferably has a nearly-square shape, an

elliptic shape or the like to prevent electric field concentration as much as possible. When a microwave having a frequency of several hundred MHz to several ten GHz is introduced from the waveguide 1, the microwave is propagated within the waveguide 1 and emitted from the slots 4 to the outside of the waveguide 1. The emitted microwave is introduced into the laser tube. Then, the excimer laser gas in the laser tube 2 is excited by the introduced microwave. Then electric field concentration occurs in the slit-shaped gap 3, causing plasma discharge. The phase of the plasma light is regulated, then the plasma light is resonated, and the excimer laser light occurs.--

The paragraph starting at page 17, line 3 and ending at line 7, has been amended as follows:

--Further, the microwave emission source is not limited to the slot array. The same advantage can be obtained by using a tapered waveguide [taperdwaveguide] or the like as long as it can supply the microwave uniformly [uniform] along the lengthwise direction of the resonance device.--

The paragraph starting at page 18, line 12 and ending at line 20, has been amended as follows:

--Next, a second embodiment of the present invention will be described. In the second embodiment, the excimer laser oscillating apparatus corresponds to that of the first embodiment is discussed [exemplified], however, the plasma generation mechanism of the second embodiment differs from that of the first embodiment. Note that constituent

elements corresponding to those of the first embodiment have the same reference numerals and the explanations of the elements will be omitted.--

The paragraph starting at page 19, line 3 and ending at line 14, has been amended as follows:

--The significant feature of the excimer laser oscillating apparatus of the present embodiment is that the waveguides 1a and 1b, which are also used as a laser tube, correspond to the waveguide [thewaveguide] 1 in the first embodiment. In this case, the laser gas is introduced into both waveguides 1a and 1b, but the microwave is directly introduced from the outside into the waveguide [thewaveguide] 1b while the microwave is indirectly introduced from the waveguide 1b into the waveguide 1a, as described later. Note that the flow direction of the laser gas is orthogonal to the gap 3, from the waveguide 1a to the waveguide 1b.--

The paragraph starting at page 19, line 20 and ending at page 20, line 6, has been amended as follows:

--First, as shown in Fig. 5A, the microwave is generated and introduced into one of the chambers of the waveguide 1, i.e., the chamber 1b. As the microwave is propagated in the chamber 1b, an electric current flows through a waveguide [awaveguide] wall. The microwave exists as a standing wave within the propagation space defined with the lengthwise direction of the chamber 1b, and the current, derived from the microwave, flowing through the waveguide [thewaveguide] wall, also exists as a standing wave. Note

that as the standing wave form of the microwave is spatial and complicated, a standing wave in a general distributed constant line is used as an index in the figures.--

The paragraph starting at page 20, line 20 and ending at line 26, has been amended as follows:

--Note that in Figs. 5A and 5B, when the microwave enters the chamber 1a of the waveguide [thewaveguide] 1 through the gap 3, positions through which mainly the microwave passes are represented with arrows and white portions for the sake of convenience. However, the white portions are not provided with slots, but the white portions are merely parts of the slit-shaped gap 3.--

The paragraph starting at page 21, line 21 and ending at page 22, line 4, has been amended as follows:

--As described above, in the excimer laser oscillating apparatus according to the second embodiment, as the gap 3 itself can be used as the laser light emission (plasma excitation) space, it is not necessary to provide an insulating member to limit the excitation space around the gap. Thus, the structure can be very easily designed. Further, plasma light emission entirely uniform along the lengthwise direction of the waveguide [thewaveguide] 1 (slit-shaped gap 3) is realized, and uniform laser light emission with minimum energy loss is enabled.--

The paragraph starting at page 22, line 7 and ending at line 15, has been amended as follows:

--Next, a third embodiment of the present invention will be described. In the third embodiment, an exposure apparatus (hereinbelow, referred to as a "stepper" for the sake of convenience) having the excimer laser oscillating apparatus described in the first embodiment (and modification) and the second embodiment as a laser light source will be exemplified. Fig. 6 is a schematic diagram showing principal constituent elements of the stepper.--

The paragraph starting at page 25, line 1 and ending at line 3, has been amended as follows:

--Next, an example of a method for fabricating a semiconductor device by utilizing the projection exposure apparatus explained in Fig. 6 will be described.--